OSI Model

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Problem

Each manufacturer developed its own network solutions and communication protocols.

IBM   SNA
DEC   DECNET
NOVELL   Netware IPX/SPX
Microsoft   NETBIOS
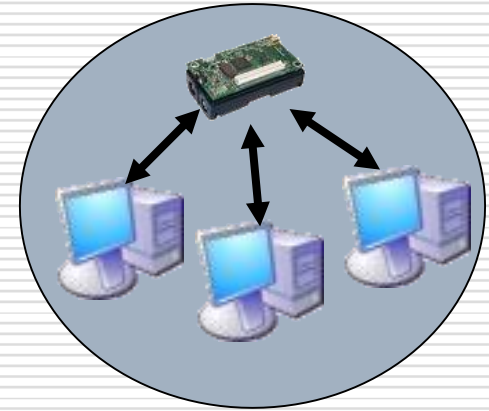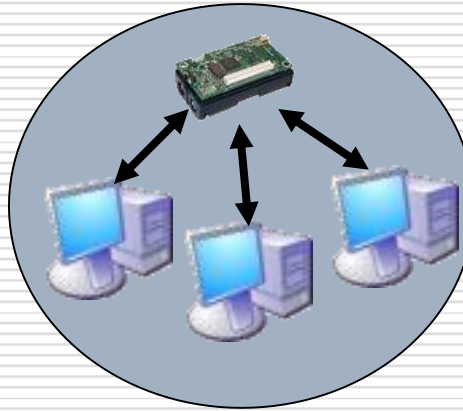Apple   APPLE TALK
VAX   VMS

Proprietary networks

Proprietary networks
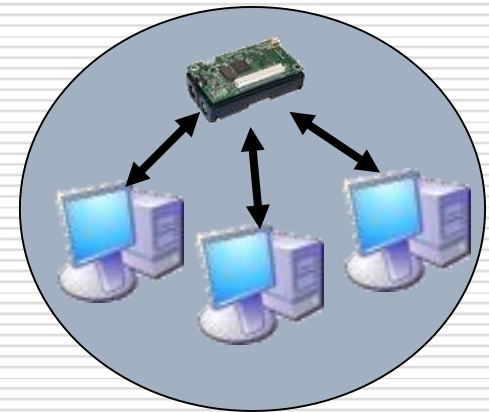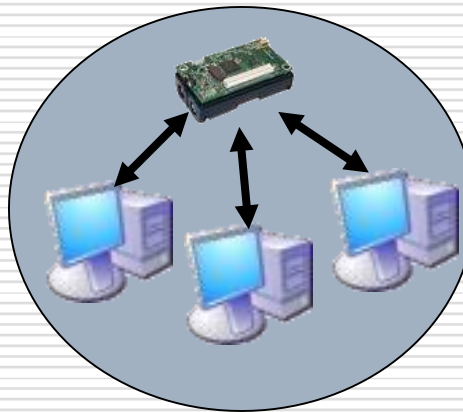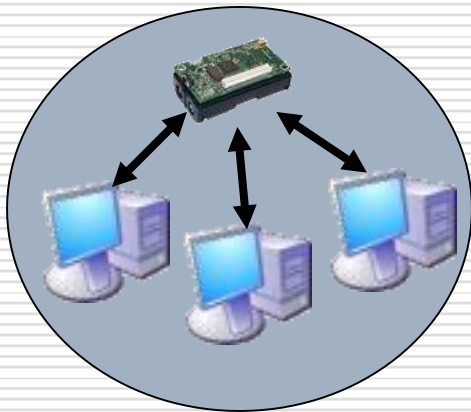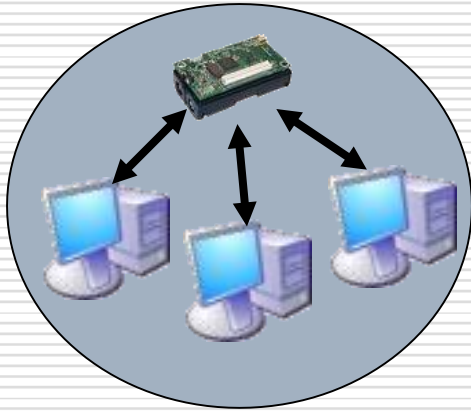
OSI Model

✓The **OSI** (Open System Interconnection) standard is established by the International Organization for Standardization (**ISO**).

Open System Definition

- An open system is a computer, terminal, network, smartphone, chip, sensor, switch, router, and more.

- Any device that follows this standard can share information:
  - With other **heterogeneous devices** designed by **different manufacturers**.

OSI layers

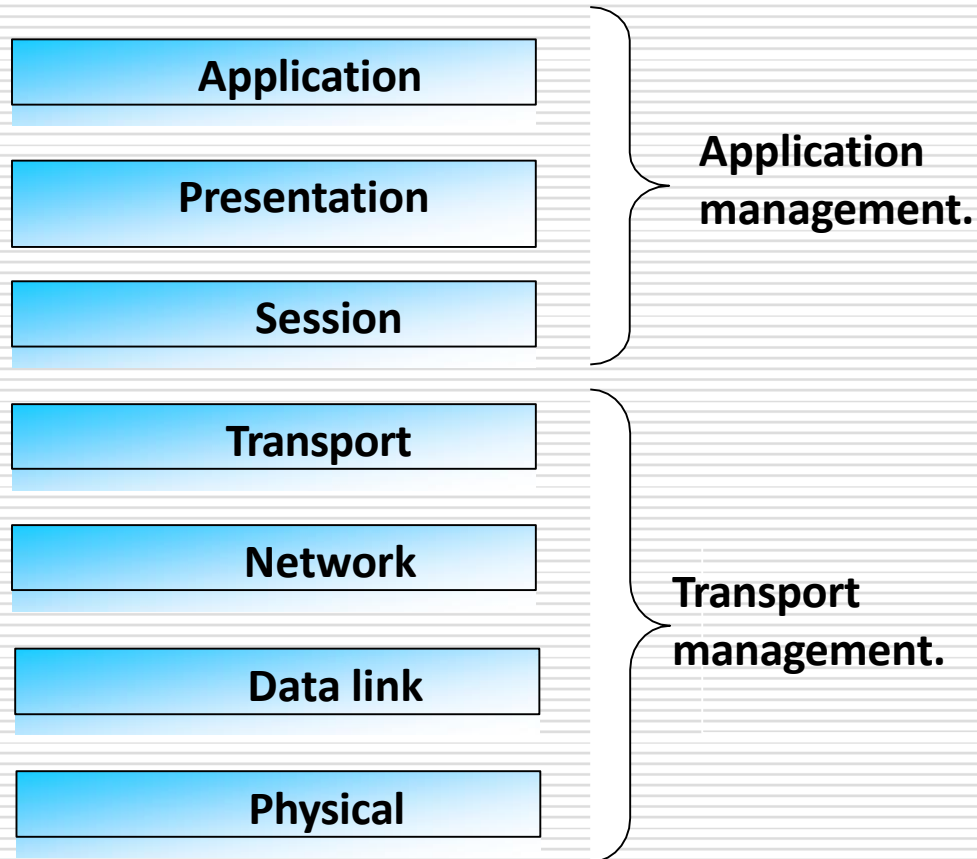| Application |
|---|

Application
management.

Presentation

Session

Transport

Network

Transport
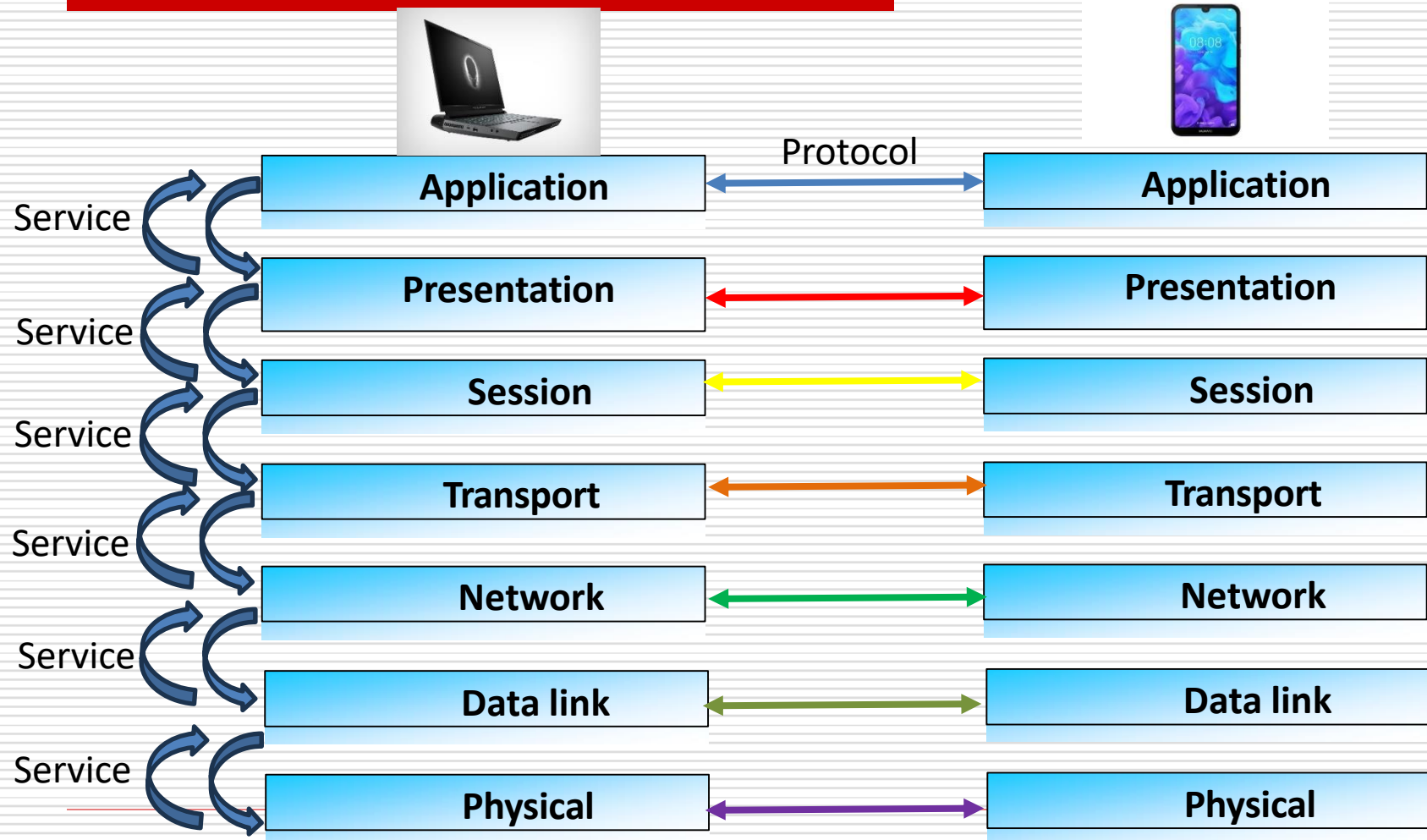management.

Data link

Physical

The OSI model consists of 7 layers, each layer solving a specific problems.
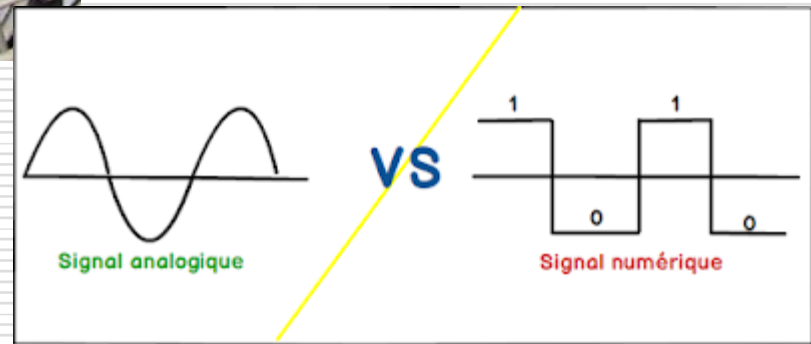
OSI Architecture

➢ Each layer N:
- Provides a **service** (N)
- Uses a **protocol** (N)
- Has a service access point (N-SAP)

Each layer uses a protocol and provides services to neighboring layers.

Architecture du modèle OSI

Physical layer
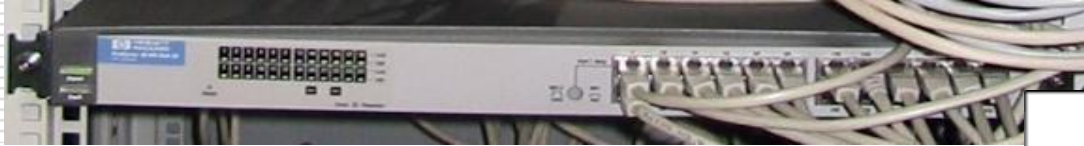
The physical layer handles aspects related to:

➢Transmission of raw bits over a physical medium

➢Hardware components like cables, switches, and network interface cards

➢Electrical, optical, or radio signals

➢Throughput (debit) , signal modulation, and synchronization

The physical layer only transmits raw bits without any specific meaning.

Data Link Layer

➢Packaging raw bits from the physical layer into data **frames**.
➢**Error detection and correction** that may occur during transmission.
➢**Flow control**: Managing the pace (rythme) of data transmission to prevent congestion between sender and receiver.
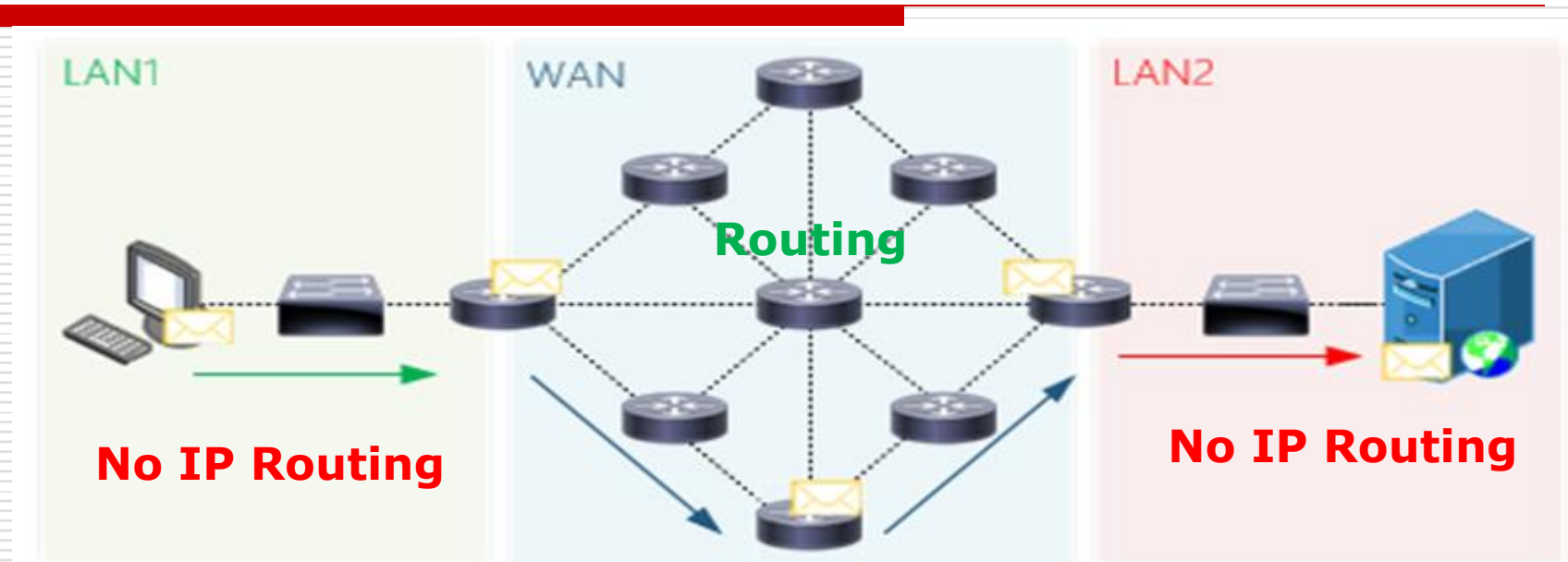
Data Link Layer

➢ **MAC addressing**: Assigning a unique Media Access Control address to each device for proper identification on the network.

➢ **Media access control**: Governing how devices share the transmission medium, using protocols like Ethernet or Wi-Fi.

handles communication only between adjacent network (neighbors) nodes.

Network layer

> **Routing:** finds the best path for data across networks**.**
> **Logical addressing**: Assigning addresses to devices for identification and communication across different networks
> **Handling traffic congestion**: Managing network congestion by controlling data flow.

Network layer
Routing packets
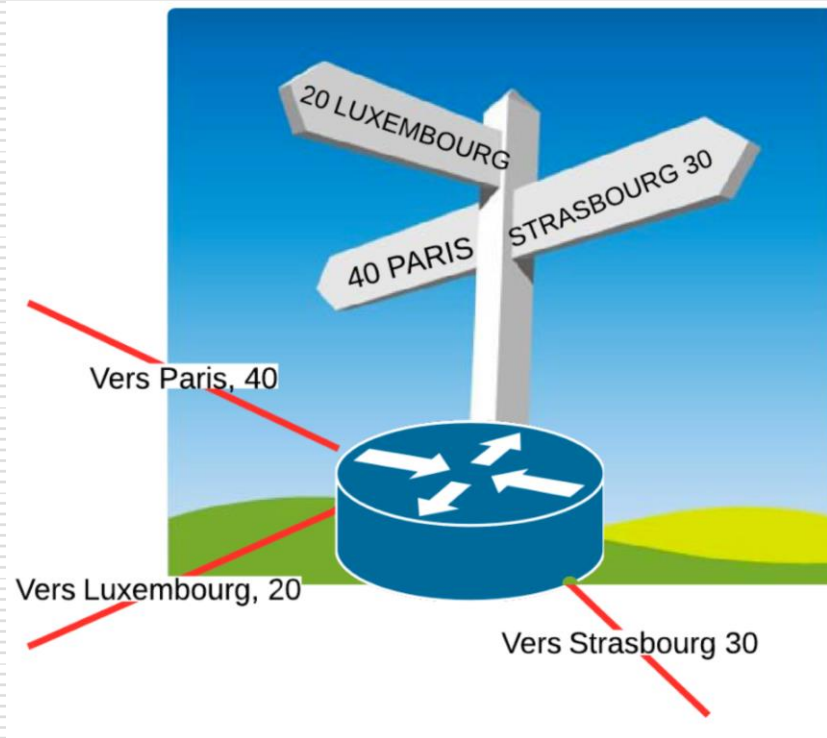
Network layer
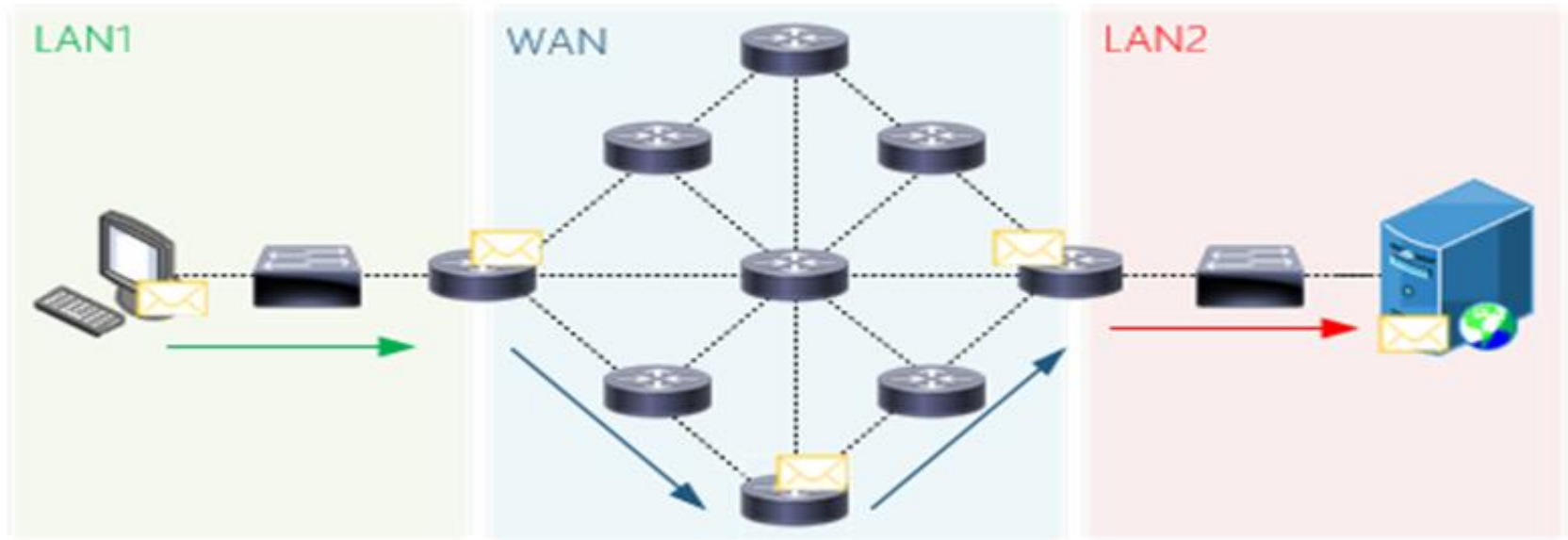
Fragmentation and reassembly: Splits large packets into smaller fragments and reassembles them at the destination.

How to find the desired application?

Transport layer
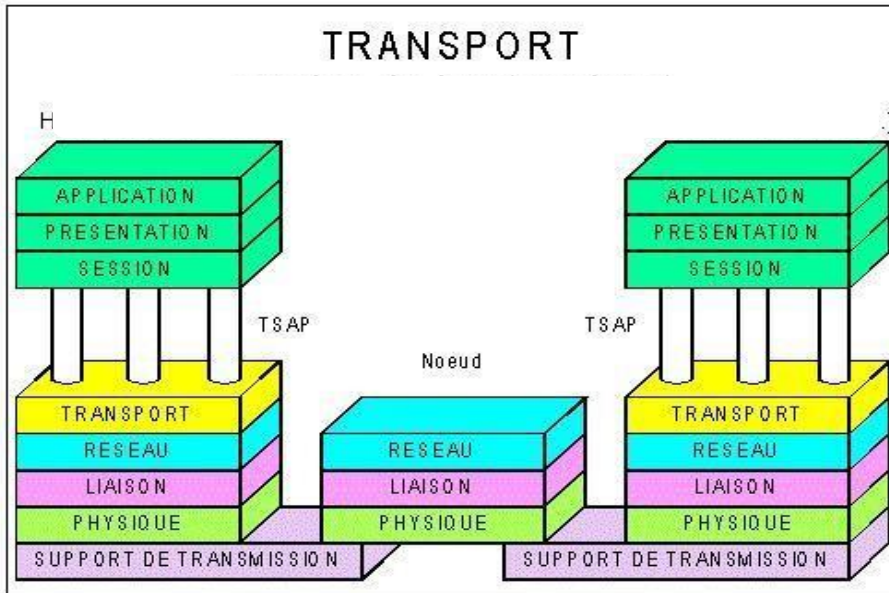
> Handles communications between **end systems**.
> **Segmentation**: Dividing large messages into smaller segments.
> **Flow control**: Regulating the data transmission rate between sender and receiver to prevent congestion.

Transport layer
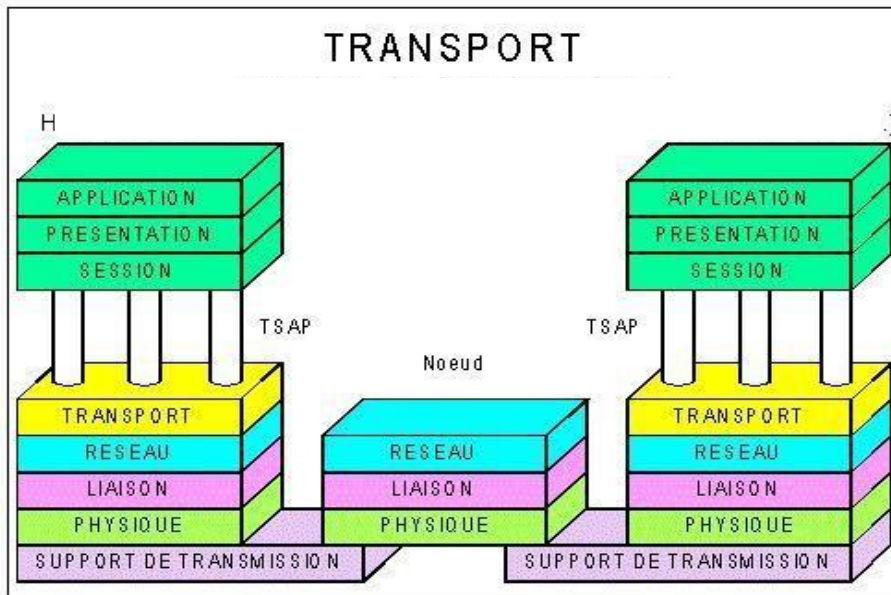
- **Connection management**: Establishing, maintaining, and closing connections between devices.
- **Reliability**: Ensuring that data is delivered accurately and in the correct order,
- Addressing Applications (Port Numbers)

Transport layer

Machine A

Machine B

Multiplexing

DemMultiplexing
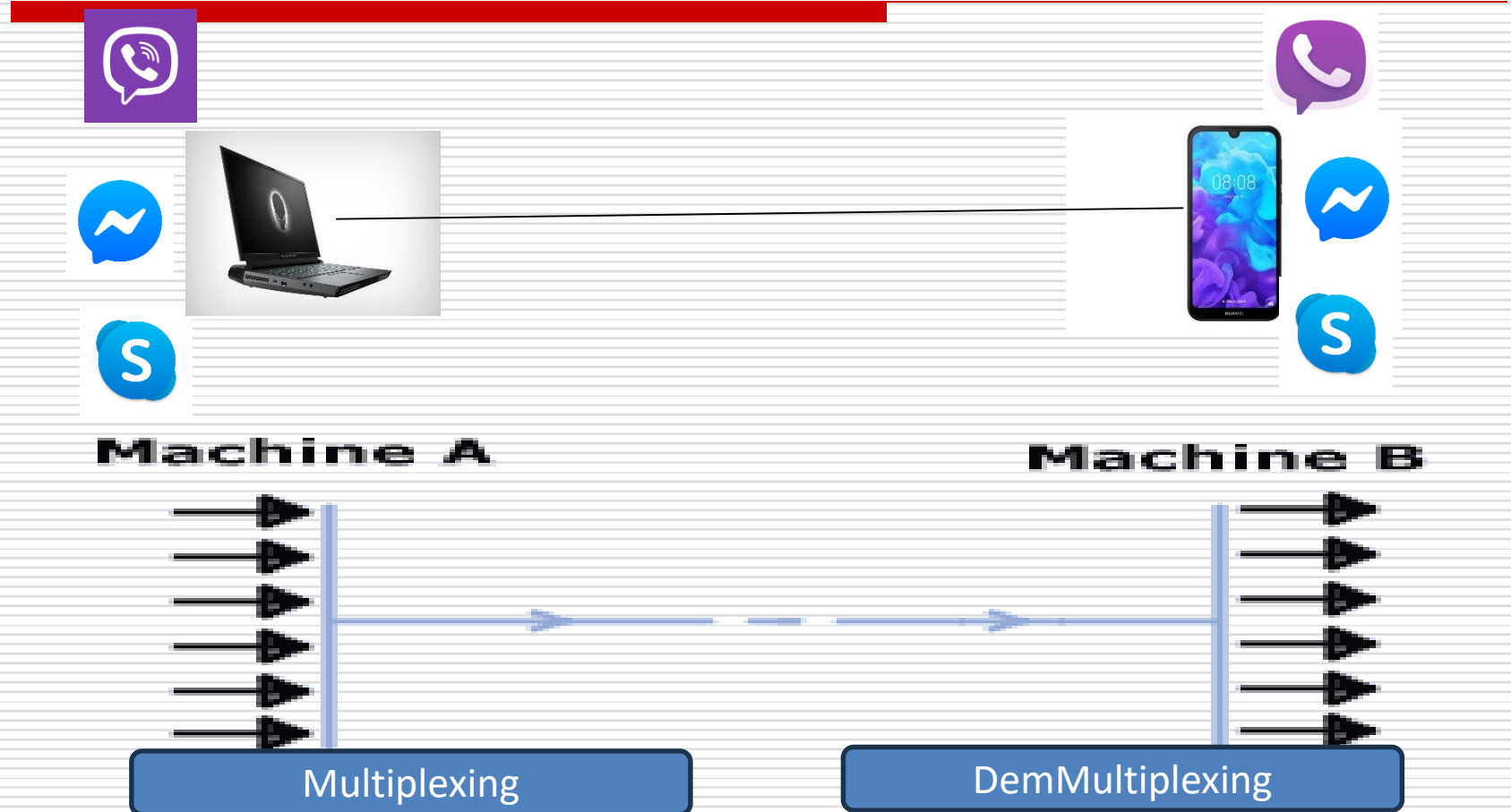
Transport layer
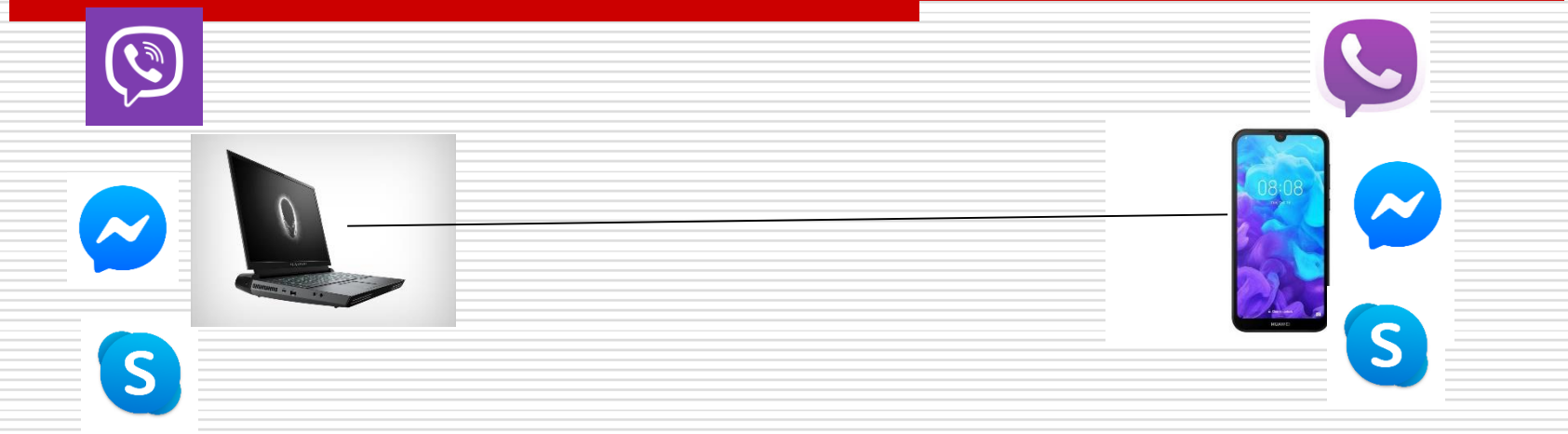
how To manage and control the dialog between two devices or systems ?

Session Layer
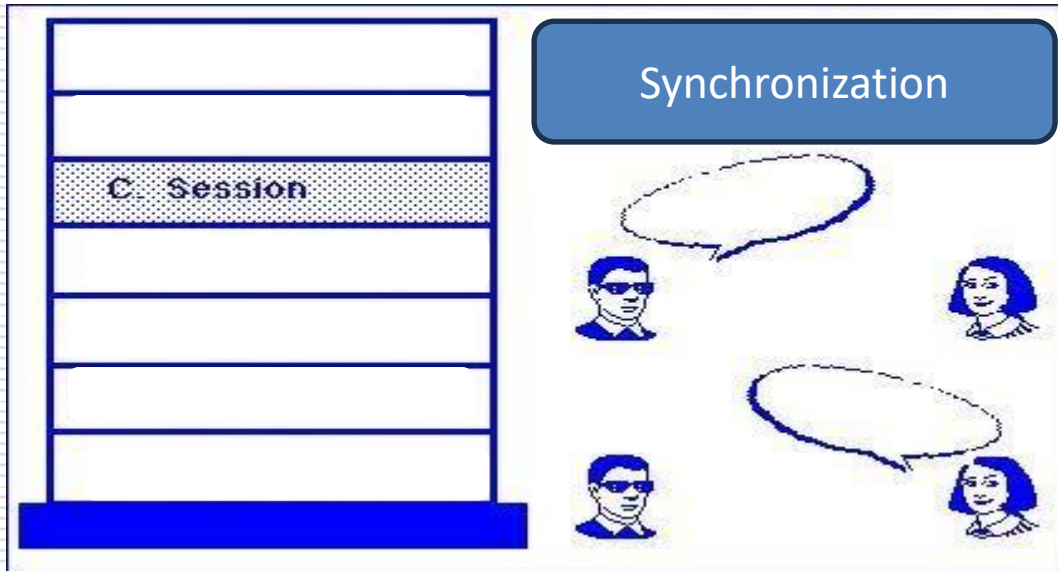
Synchronization

(User, Password, etc.)

➢ Establishing, **Maintaining**, closing (properly) and Synchronization **(**Resynchronization**)** sessions
➢ Managing Dialogs (half-duplex or full-duplex)

Session Layer
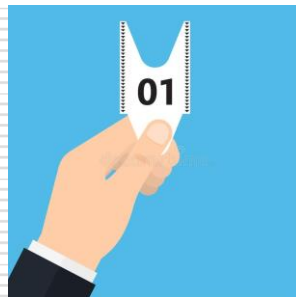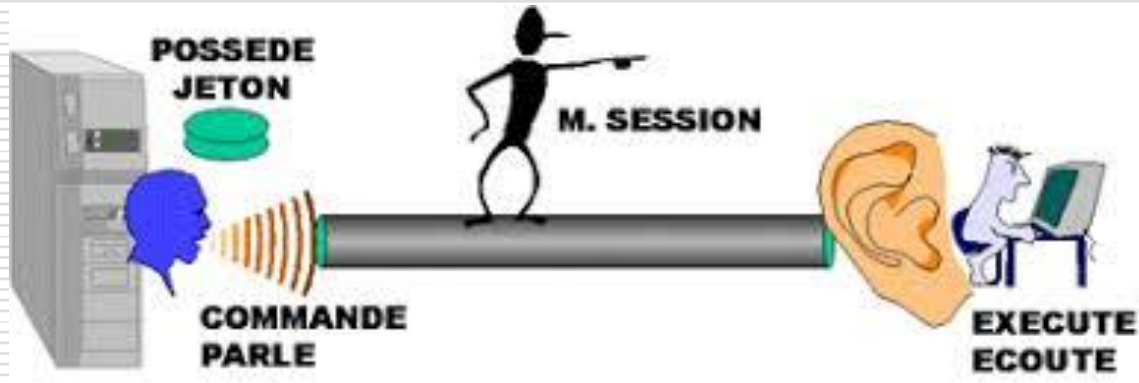
What data type to send?

Presentation Layer

It represents data independently of computers and operating systems, and includes services like:

Data Translation (Converts data between different formats used by applications**):**

Data Formatting
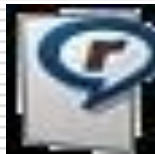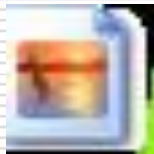
Data Encryption/Decryption

Data Compression/Decompression

Presentation Layer

Data Translation:
•**Converts data** between different formats used by applications. For example, translating between character encoding formats like ASCII, EBCDIC, or Unicode.

Data Encryption/Decryption:
•Encrypts data for secure transmission and decrypts it upon receipt **to protect information during communication.**

Data Compression/Decompression:
•Compresses data **to reduce its size for efficient transmission**, and decompresses it at the receiving end to restore the original data format.

Data Formatting:
•Ensures that data structures (e.g., file formats like JPEG, PNG, or MP4) are in the **correct format** to be interpreted by the receiving system.

Presentation layer
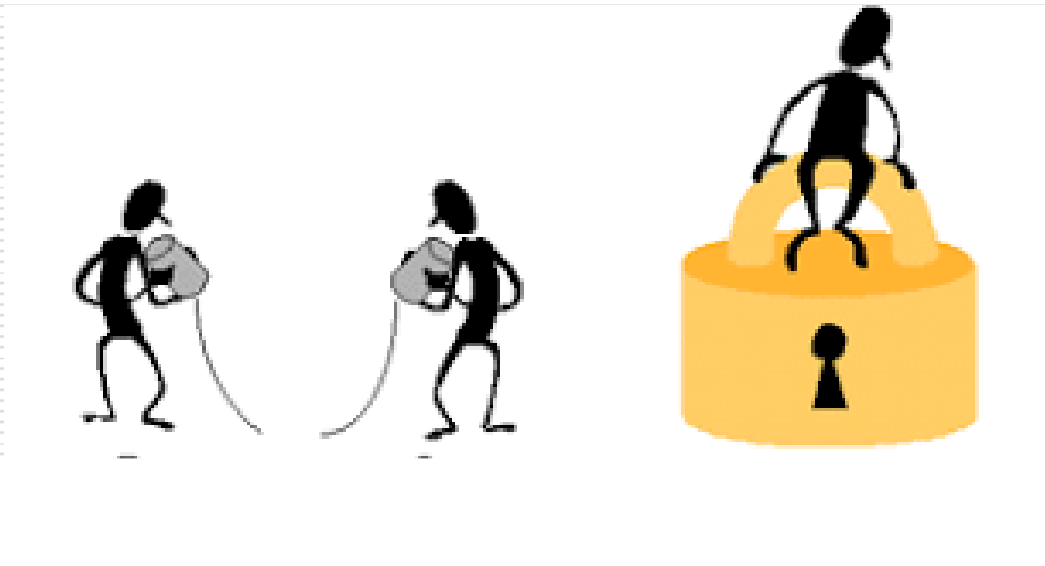
But who will benefit from all this?

Application layer

- Interface between the end-user and the network

- It provides various **services** and **protocols** that applications use to communicate over a network

- Examples of protocols:

  - **HTTP** (Hypertext Transfer Protocol) for web browsing
  - **FTP** (File Transfer Protocol) for transferring files
  - **SMTP** (Simple Mail Transfer Protocol) for sending emails
  - **DNS** (Domain Name System) for resolving domain names to IP addresses

Application layer

OSI Model Summary

7. Application
Network process to application
DNS, WWW/HTTP, P2P, EMAIL/POP, SMTP, Telnet, FTP

6. Presentation
Data representation and encryption
Recognizing data: HTML, DOC, JPEG, MP3, AVI, Sockets

5. Session
Interhost communication
Session establishment in TCP, SIP, RTP, RPC-Named pipes

4. Transport
End-to-end connections and reliability
TCP, UDP, SCTP, SSL, TLS

3. Network
Path determination and logical addressing
IP, ARP, IPsec, ICMP, IGMP, OSPF

2. Data Link
Physical addressing
Ethernet, 802.11, MAC/LLC, VALN, ATM, HDP, Fibre Channel,
Frame Relay, HDLC, PPP, Q.921, Token Ring

1. Physical
Media, signal, and binary transmission
RS-232, RJ45, V.34, 100BASE-TX, SDH, DSL, 802.11

Number of Layers per Device.

- **Communication Equipement**:   07 Layers

- **Interconnexion Equipement**: <=07 layers Based on the role of the equipment.

Number of Layers per Device.

PC

Router

Hub
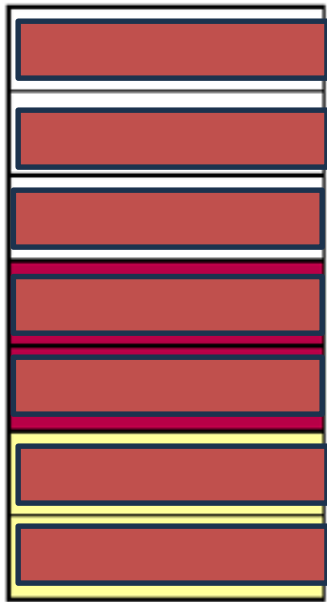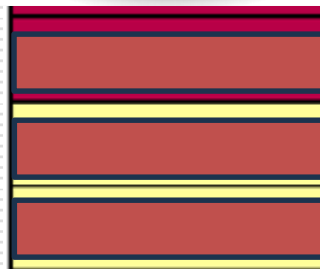
How is data transfer done?

Data transmission and encapsulation

Data transmission and encapsulation

- Data transmission and encapsulation in the OSI model is a structured and organized process that ensures reliable communication between devices

- Each layer of the OSI model has a specific role in encapsulating and transmitting data

Data transmission

Data transmission

7. APPLICATION LAYER

6. PRESENTATION LAYER

5. SESSION LAYER

4. TRANSPORT LAYER

3. NETWORK LAYER

2. DATA LINK LAYER

1. PHYSICAL LAYER

Data transmission
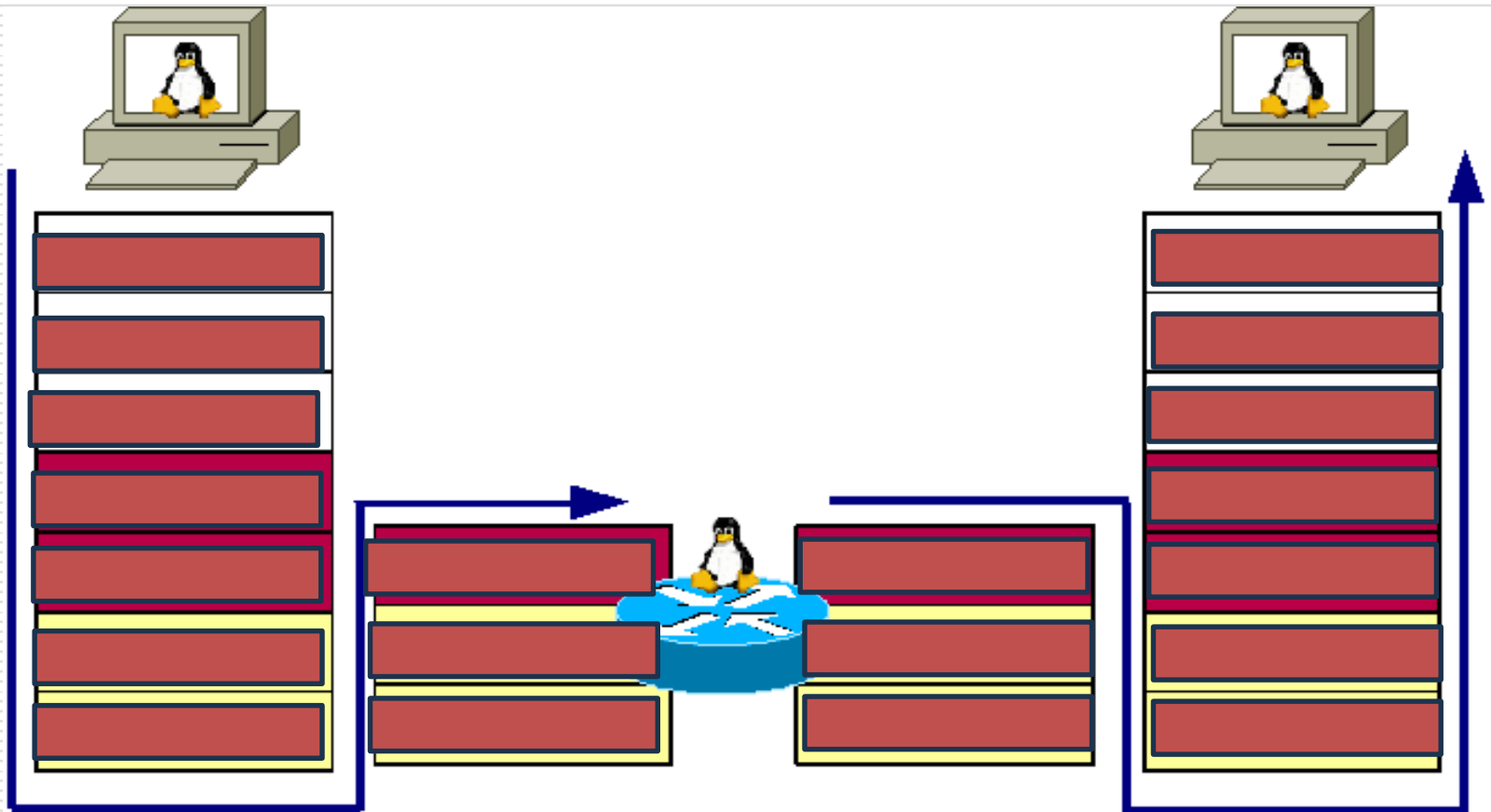
Data encapsulation

Data transmission

7. APPLICATION LAYER

6. PRESENTATION LAYER

5. SESSION LAYER

4. TRANSPORT LAYER

3. NETWORK LAYER

2. DATA LINK LAYER

1. PHYSICAL LAYER

Data encapsulation

Sending side : Encapsulation Process
•As data **moves down** through the OSI layers, each layer adds its own header (and sometimes a trailer) to the data unit:

•**Application Layer**: Data (The user generates data, e.g., sending an email
•**Presentation Layer**: Data (formatted….)
•**Session Layer**: Data (session information is managed)
•**Transport Layer**: Segment
•**Network Layer**: Packet
•**Data Link Layer**: Frame
•**Physical Layer**: Bit stream

Data encapsulation

Receiving Side:

Physical Layer: Receives the signals and converts them back into frames.
Data Link Layer: Removes the frame header and extracts the packet.
Network Layer: Removes the packet header and extracts the segment.
Transport Layer: Removes the segment header and reassembles the data.
Session Layer: Removes the header and Manages and synchronizes the data exchange, ensuring that sessions are properly maintained.
Presentation Layer: Removes the header and Converts the data into a format usable by the application, applying any necessary decryption or decoding.
•**Application Layer**:The original application data is presented to the user or application.

Data encapsulation

		Application Protocol				APDU
7	Application				Application	
6	Presentation	Presentation Protocol			Presentation	PPDU
5	Session	Session Protocol			Session	SPDU
4	Transport	transport Protocol			Transport	TPDU
3	Network	Network	Network		Network	packet
2	Data link	Data link	Data link		Data link	Trame
1	Physical	Physical	Physical		Physical	Bit

Hote A   Router   Router   Hote B
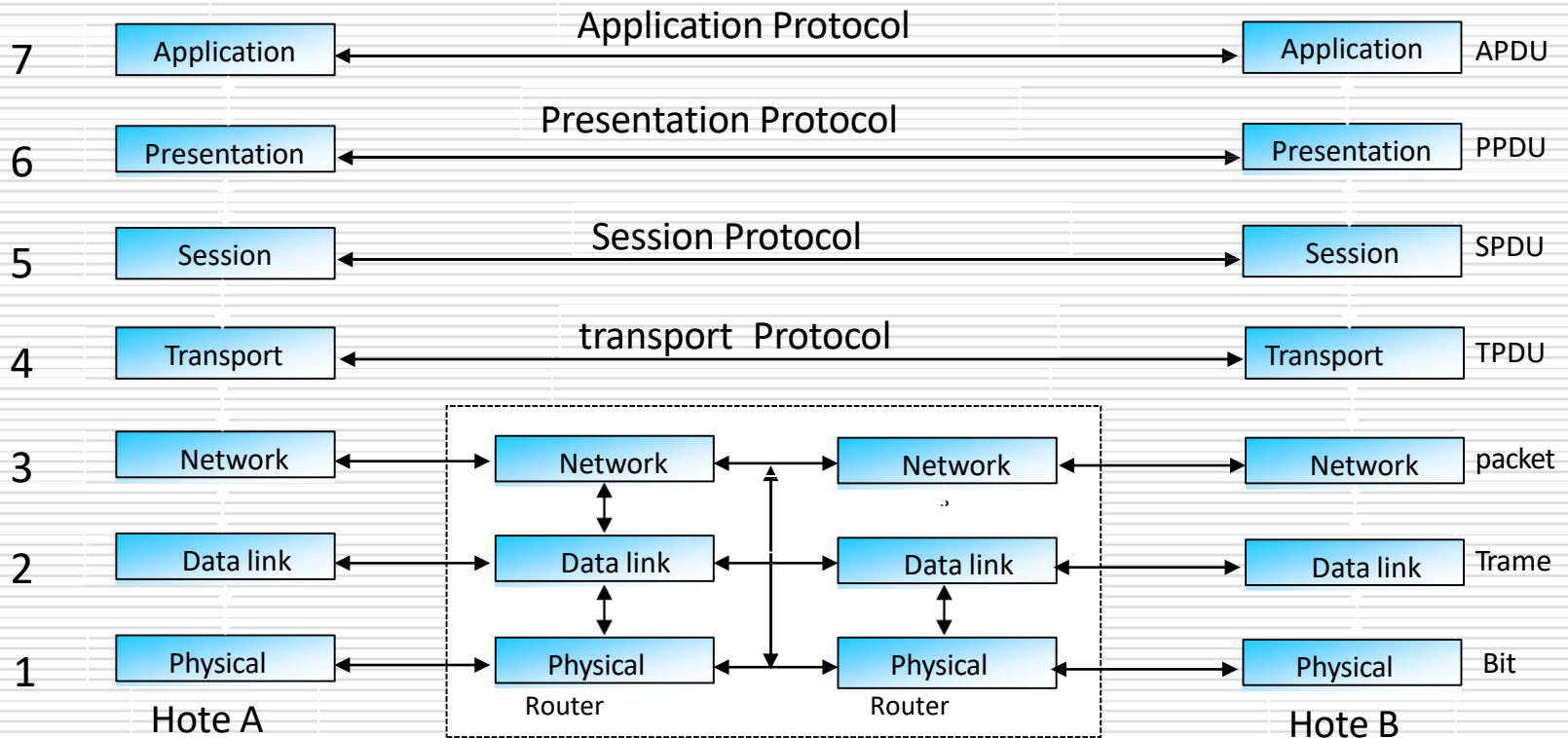
XPDU : (Protocol Data Unit) Protocol Data Unit of Layer X..

Data encapsulation

I send my photo to Amine via Facebook.

Amine

Léo

	Donnée		

App		AH	Donnée		**App**
Pr		PH	Donnée		**Pr**
SS		SH	Donnée		**SS**
Tr		TH	Donnée		**Tr**
Rx		NH	Donnée		**Rx**
L-D		DH	Donnée	DT	**L-D**
Phy		—0101010111110111110011000011101101110110110110—			**Phy**

Data transmission channel.
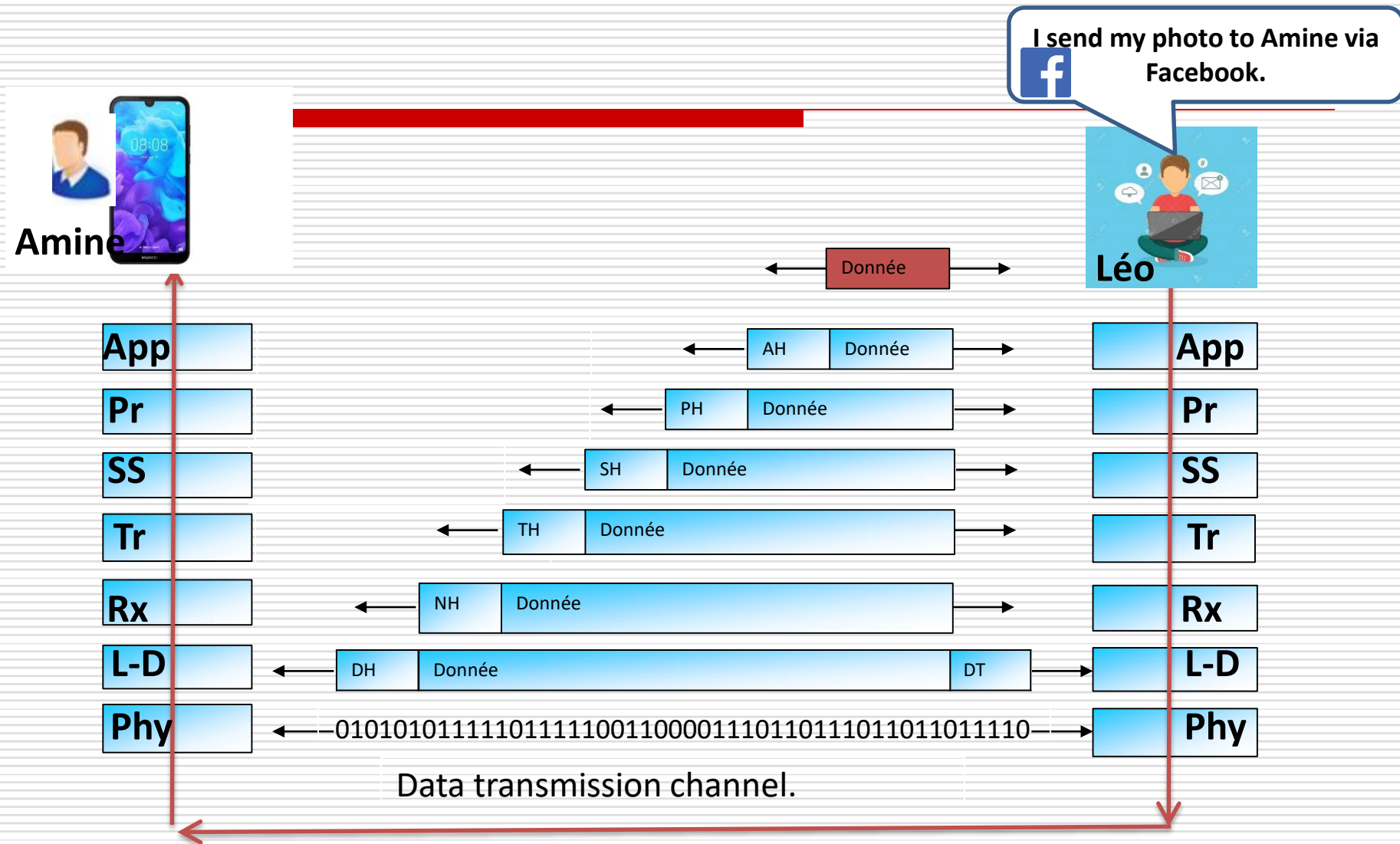
Conclusion

➢OSI model is essential for understanding the basics of networks.

➢In the next chapter, we will discuss one of the most commonly used models in practice, especially on the Internet:.

The TCP/IP model

Exercice